

## WHAT IS CLAIMED IS:

1. A hollow nanocrystal, comprising:
 

a nanocrystal shell having a thickness of at least 0.5 nm,  
 said nanocrystal shell enveloping an empty space, wherein,  
 said nanocrystal shell is not perfectly single crystalline.
2. The hollow nanocrystal as claimed in claim 1, wherein:
 

the shell thickness is between about .5 nm and 100 nm.
3. The hollow nanocrystal as claimed in claim 2, wherein:
 

the shell thickness is between about 2 nm and 80 nm.
4. The hollow nanocrystal as claimed in claim 3, wherein:
 

the shell thickness is between about 3 nm and 10 nm.
5. The hollow nanocrystal as claimed in claim 1, wherein:
 

the shell comprises a material selected from the group consisting of  
 Pt, ZnS, ZnSe, ZnTe, ZnO, CoO, Co<sub>3</sub>O<sub>4</sub>, Fe<sub>2</sub>O<sub>3</sub>, FeP, Fe<sub>3</sub>O<sub>4</sub>, FeO, TiO<sub>2</sub>, CdS,  
 CdSe, CdTe, HgS, HgSe, HgTe, MgTe, GaN, GaP, GaAs, GaSb, InN, InP, InAs,  
 InSb, AlAs, AlP, AlSb, AlS, Co<sub>9</sub>S<sub>8</sub>, Co<sub>3</sub>S<sub>4</sub>, CoSe, GaMnAs, GaInN and InAsN.
6. The hollow nanocrystal as claimed in claim 1, wherein:
 

the shell comprises a material selected from the group consisting of Co<sub>9</sub>S<sub>8</sub>, Co<sub>3</sub>S<sub>4</sub>,  
 CoO, Co<sub>3</sub>O<sub>4</sub>, CoSe, CdS, Fe<sub>2</sub>O<sub>3</sub>, CdSe and Pt.
7. The hollow nanocrystal as claimed in claim 5, wherein:
 

the shape of the hollow nanocrystal is either spherical, branched, tubular or disk.
8. The hollow nanocrystal as claimed in claim 7, wherein:
 

the shape of the nanocrystal is spherical, and  
 the outside diameter is between about 1 nm and 1000 nm.

9. The hollow nanocrystal as claimed in claim 8, wherein:  
the outside diameter is between 1 nm and 500 nm.
10. The hollow nanocrystal as claimed in claim 9, wherein:  
the outside diameter is between 5 nm and 100 nm.
11. The hollow nanocrystal as claimed in claim 10, wherein:  
the outside diameter is between 10 nm and 50 nm.
12. The hollow nanocrystal as claimed in claim 11, wherein:  
the outside diameter is between 10 nm and 30 nm.
13. The hollow nanocrystal as claimed in claim 1, wherein:  
the hollow nanocrystal shell comprises a binary or ternary compound, wherein  
said binary and/or ternary compound comprises a first material and a second  
material, wherein:  
the first material comprises a material selected from the group consisting of Pt,  
Zn, Co, Fe, Ti, Cd, Hg, Mg, Ga, In, Al, Ni, Sn and Bi; and  
the second material is selected from the group consisting of S, Se, O, P, N, F, Cl,  
I, Br, As and Sb.
14. The hollow nanocrystal as claimed in claim 13, wherein:  
the diffusion rate for the first material is different than the diffusion rate for the  
second material.
15. The hollow nanocrystal as claimed in claim 7, wherein:  
the nanocrystal has a disk shape, and  
the outside diameter is between about 10 nm to about 200 nm.
16. The hollow nanocrystal as claimed in claim 15, wherein:  
the outside diameter is between about 10 nm and 100 nm.
17. The hollow nanocrystal as claimed in claim 15, wherein:

the outside diameter is between about 25 nm and 50 nm.

18. The hollow nanocrystal as claimed in claim 7, wherein:

the nanocrystal has a tubular shape, and

the length is between about 30 nm to about 500  $\mu\text{m}$ .

19. The hollow nanocrystal as claimed in claim 18, wherein:

the length is between about 50 nm and 200  $\mu\text{m}$ .

20. The hollow nanocrystal as claimed in claim 19, wherein:

the length is between about 50 nm and 20  $\mu\text{m}$ .

21. A method of making a hollow nanocrystal, comprising

providing a nanocrystal comprising a first material,

reacting the nanocrystal with a second material,

wherein the first and second material react to form a shell of a hollow nanocrystal.

22. A method of making a hollow nanocrystal as claimed in claim 21, wherein:

the first material comprises a material chosen from the group consisting of

Al, Ga, In, Tl, Sn, Pb, Bi, Po, Sc, Ti, V, Cr, Mn, Fe, Co, Ni, Cu, Y, Zr, Nb, Mo,

Tc, Ru, Rh, Pd, Ag, Cd, La, Hf, Ta, W, Re, Os, Ir, Pt, Au, Hg, Li, Na, K, Rb, Cs,

Be, Mg, Ca, Sr, Ba, Ge, Si, Se, Te, FeCo, CoNi and CdZn.

23. A method of making a hollow nanocrystal as claimed in claim 21, wherein:

the second material comprises a material chosen from the group consisting of S,

O, Se, Te, P, N, As, Cl, I, Br and Bi.

24. A method of making a hollow nanocrystal as claimed in claim 23, wherein:

the second material comprises a material chosen from the group consisting of S,

O, Se and Te.

25. A method of making a hollow nanocrystal as claimed in claim 21, wherein:

the second material comprises sulfur in solution, and

the second material is combined with a solution containing the first material to make a sulfide hollow nanocrystal.

5 26. A method of making a hollow nanocrystal as claimed in claim 21, wherein:

the second material comprises O, and

a gaseous mixture containing the second material is combined with a solution containing the first material,

thereby making an oxide hollow nanocrystal compound.

) 27. A method of making a hollow nanocrystal as claimed in claim 21, wherein:

the second material comprises O, and

and the second material is in solution and is combined with a solution containing the first material,

thereby making an oxide hollow nanocrystal compound.

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